Editorial

Transferring patients for primary infarct angioplasty

Although primary angioplasty (PTCA) achieves reperfusion in acute myocardial infarction (AMI) more readily than thrombolysis without the risk of intracranial haemorrhage, economic and logistic issues limit its applicability.[1] Most patients with AMI present to hospitals without cardiac catheterisation facilities, let alone PTCA expertise. The safety and feasibility of the emergency transfer of such patients for primary PTCA have been reported by Zijlstra *et al* in Zwolle, a high volume centre in the Netherlands performing 1600 angioplasties annually.[2] During five years there were 520 cases of primary PTCA, 104 of which were transferred from other hospitals, 91% from within a 50 km radius. One patient was ventilated before transfer. During transfer, another was intubated, three patients had ventricular fibrillation or tachycardia, and one of 10 patients in cardiogenic shock on inotropic support died. Although the time lost between admission to the local hospital and arrival at the PTCA laboratory averaged 70 minutes, the first balloon inflation was performed within six hours of symptom onset in 78% of cases. In this well established programme, there was no difference in mean time from symptom onset to first inflation between transferred (200 minutes) and directly admitted (196 minutes) patients.

The Hull experience

Our tertiary centre serves a population of 1.2 million and performs over 400 PTCA procedures each year. During two years, 83 patients with AMI received rescue (n = 53) or primary (n = 30) PTCA. We offer a 24 hour primary PTCA service for patients who appear not to benefit from or cannot receive thrombolysis. For certain patients, we feel that the greater likelihood of restoring coronary patency earlier is a decisive factor in preferring PTCA to thrombolysis. Although we do not operate a time restrictive policy because it can be difficult to be exact about the time of acute coronary occlusion, we emphasise the need to minimise delay in transferring suitable patients. We believe that unremitting symptoms plus persistent electrocardiographic ST changes are more important than an estimate of the time of symptom onset in recommending emergency transfer for PTCA. No deaths have occurred during transfer over the past two years. With our clinically driven policy of selecting high risk cases, the median time to primary PTCA was four hours; there was no major difference in outcome between patients undergoing PTCA within four hours or later.

Which patients should be transferred?

It is difficult to justify a "door to first balloon inflation" time that exceeds a "door to needle" (to reperfusion) time if the average patient—whether transferred or admitted directly—would do just as well with prompt thrombolysis. Thus, the principal indications for primary PTCA should be broadly: lack of benefit from thrombolysis, ineligibility for thrombolysis, and uncertainty about reperfusion efficacy when it is paramount. Common to all should be the perception that a sizeable area of myocardium is in jeopardy. In Zijlstra *et al*'s study,[2] the indications for transfer were anterior AMI in 67% of cases, large AMI with a contraindication to thrombolysis in 31%, and Killip class 3 or 4 in 13%. In our series, primary PTCA was performed because of a large AMI ineligible for thrombolysis in 37% of cases, young age usually with a large AMI in 27%, AMI with ST depression in 23%, and presentation in cardiogenic shock in 13%. Thirty per cent had triple vessel disease and 30% required intra-aortic counterpulsation, reflecting our case selection based on adverse clinical factors.

In Seattle, Washington, USA, the use of reperfusion treatments has had minimal impact on overall mortality largely because fewer than a third of patients—relatively low risk—are eligible to receive them.[3 4] To obtain the greatest benefit, the highest risk cases should be selected. In ISIS-2, early mortality was 19% in AMI characterised by ST depression.[5] In an overview, it was 15.3% for the subset treated with thrombolysis, compared with 9.6% in the entire population receiving thrombolysis.[6] The observation that ineligibility for thrombolysis carries a high risk[7] has been confirmed by the Israeli experience in which in-hospital mortality was 15%, compared with 6% for those undergoing primary PTCA, and 6% for those receiving thrombolysis within the GUSTO-I protocol.[8] Those ineligible for thrombolysis according to GUSTO criteria, but were nonetheless treated with streptokinase outside of protocol, had a similarly high in-hospital mortality of 15%.[8] Thus, if patients cannot receive thrombolysis but so much myocardium is at stake that aspirin (with or without intravenous β blockade or magnesium) is deemed unlikely to restore patency early enough, PTCA should be considered.

Finally, in the GUSTO-I trial, 58% of all deaths at 30 days were associated with cardiogenic shock.[9] Compared with a mortality rate of 80% in the prethrombolytic era,[10] survival in cardiogenic shock has improved with thrombolysis, but 30-day mortality remains high at 55% (43% if rescue PTCA performed, 61% if not).[9] Although accelerated t-PA was better than streptokinase at preventing shock, treatment with streptokinase showed a trend in mortality reduction when shock was already present on admission, supporting an earlier report of lower mortality when streptokinase (65%) was used rather than t-PA (78%).[11] Even after primary PTCA, cardiogenic shock remains the most common cause of mortality.[12] Patients in cardiogenic shock are less likely to have successful PTCA.[13] Mortality when the infarct related artery remains occluded is 75% *v* 33% when it is open early.[14] These observations in patients with cardiogenic shock underscore their high risk at baseline, and the goal of management must be to achieve and sustain patency—despite low coronary perfusion pressures—as expediently as possible.

Unresolved issues

Despite the appeal of PTCA in cardiogenic shock, there are no randomised data to encourage its use. However, randomised studies are in progress in North America[15] and Britain, where the HEROICS (How effective are revascularisation options in cardiogenic shock?) trial will help to define a national strategy for this high risk group whose management can be ethically fraught. In these and other candidates for PTCA, it is not known whether a provisional strategy of starting intravenous streptokinase, magnesium

or a bolus of antiplatelet IIB/IIIA receptor antibodies (abciximab) just before transfer is beneficial, although such pretreatment may partially compensate for the possibility of delay in transfer. Stenting may also offset the increased risk of PTCA associated with recent lysis, although this is not proved. At the William Beaumont Hospital, Royal Oak, Michigan, USA, where primary PTCA is routine and not reserved for high risk cases, thrombolysis before transfer is advised if anticipated delay exceeds 120 minutes.[16]

How long a patient is already into an infarct may influence the decision to transfer because adding the estimated transfer time may take the patient beyond the window for benefit. However, it is not known whether a $\geq$ 90% chance of TIMI-3 flow at 6–8 hours into AMI treated with PTCA is better than a 50–60% chance of TIMI-2–3 flow at 4–6 hours with thrombolysis. A randomised trial in high risk AMI patients presenting to community hospitals is planned in the Netherlands to determine whether primary PTCA after transfer to an interventional centre is better than thrombolysis on-site, minus any risk of transfer and delay to reperfusion. Such trials will also provide some insight to the wider uncertainty about whether more lives and money are saved with a strategy of primary PTCA for selected high risk cases and thrombolysis for the rest, rather than the popular default policy of thrombolysis for all eligible patients, reserving transfer for rescue PTCA only if thrombolysis fails resulting in clinical deterioration. Finally, no randomised data exist to guide clinicians in the management of AMI in patients with coronary bypass grafts or who present more than 12 hours into their infarction but remain at high risk of death.

Practical implications

In the Seattle registry, 12% of all patients with AMI received primary PTCA.[4] In Zwolle serving a population of 1.4 million, an average of 21 patients each year were transferred for primary PTCA, although recent figures may be higher.[2] The additional workload is hardly onerous with a selective rather than a routine policy, and indeed may be eased by qualified district cardiologists sharing the call roster for primary PTCA at the tertiary centre. A patchy ad hoc as opposed to a 24 hour service is unlikely to be sufficient to maintain competence, and equally important, sustain district hospital confidence in, and cooperation with, the tertiary service. Population, transportation, and hospital demographics will determine any operation of a hub-and-spoke model, where high volume interventional laboratories are designated referral centres for primary PTCA cases transferred from hospitals within a prescribed radius or transfer time.

An efficient seamless system for transferring patients for primary PTCA depends on support from district hospital emergency departments or admission units, to physicians, to the ambulance service. In bypassing the process of admission to two separate coronary care units, delay is minimised by rapid accurate assessment on arrival followed by speedy dispatch directly to the interventional laboratory for final evaluation by an experienced cardiologist. We do not currently advocate the insertion of pulmonary artery catheters or intra-aortic balloon pumps before transfer because this inevitably contributes to delay and complicates the transportation process. It is unlikely that even high risk haemodynamically or electrically unstable patients suffer avoidable deaths during interhospital transfer as long as the transfer team includes a member fully trained in cardiopulmonary resuscitation.

At present, the most practical strategy seems to be to give thrombolysis promptly to the majority of patients with AMI who may benefit (reserving the option of rescue PTCA for those who fail thrombolysis), while urgently transferring high risk patients (for whom thrombolysis is hazardous or of unproven benefit) to a designated centre for primary PTCA. Formalising even such a reasonable strategy requires political and logistic issues to be addressed.

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